JUNE 15, 1918

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AVIATION AND AERONAUTICAL ENGINEERING

(C) Western Newspaper Union Italian Naval Flying Boat Patrolling the Skies of Venice

VOLUME IV
Number 10

PRICE Fifteen Cents

SPECIAL FEATURES

THE IMPORTANCE OF NUMBERS IN AERIAL WARFARE
THE MODEL M. T. 2 LAWSON BIPLANE
THE 240 HP., 8-CYLINDER MERCEDES ENGINE
THE SPAD TWO-SEATER FIGHTER
THE MODEL C.V L. V. G. BIPLANE

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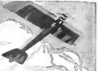
THE GARDNER, MOFFAT CO., Inc.
120 W. 32nd ST. NEW YORK



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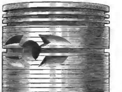

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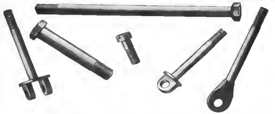

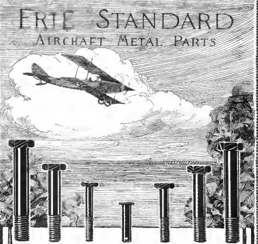
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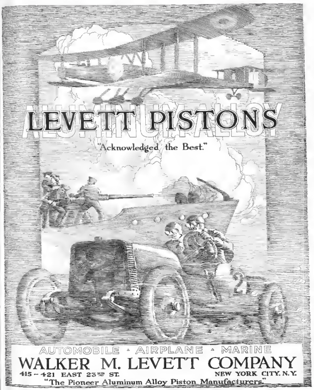
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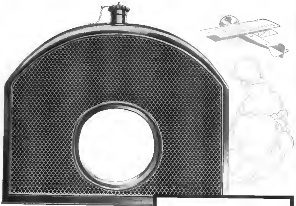


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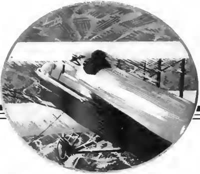

JUNE 15, 1918 **AVIATION AND AERONAUTICAL ENGINEERING** VOL. IV. NO 10

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INDEX TO CONTENTS

THE GARDNER - MOFFAT COMPANY, Inc., *Publishers*
120 WEST 32D STREET, NEW YORK
WASHINGTON OFFICE, 310 EVENING STAR BUILDING

SUBSCRIPTION PRICE TWO DOLLARS PER YEAR SINGLE COPIES FIFTEEN CENTS. CANADA AND FOREIGN TWO DOLLARS AND A HALF A YEAR.

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W. D. MOFFAT, PRESIDENT
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AVIATION AND AERONAUTICAL ENGINEERING

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Vol. IV June 15, 1918 No. 10

Importance of Numbers in Aerial Warfare

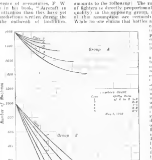
By Dr. J. G. Coffin and H. T. Booth

The Curtiss Engineering Corp

The English pioneer in the science of aeronautics, F. W. Lanchester, has several chapters in his book, "Aircraft in Warfare," which merit far more attention than they have yet received. The book teems with predictions written during the period immediately following the outbreak of hostilities, September to December, 1914, which by now have been borne out in a most complete and astonishing fashion.

Two chapters on the effect of concentration are especially interesting when applied to aerial warfare, and they point the way quite clearly toward aerial supremacy. The results are given without demonstration and partially on this account, as well as on account of the intrinsic information therein contained, the present article seems to us to be not without interest, especially at the present time.

The devising and building of a new type of airplane which has "quality" superiority over the best existing type is a slow, difficult and costly process. The emphasis is on the word "slow." Time is precious just now, and an important question immediately arises. By what factor can "quality" be overcome? The answer is conclusive, it is "number" or "quantity." We do not deny any advantage derivable from quality, but quantity is at once obtainable.



Graph Showing Value of Quantity

There are in existence today a number of very efficient fighting machines of the different types. Any new "quality" which can conveniently be incorporated in the machines is, of course, an added advantage, but as the article shows, the superiority of quantity is overwhelming.

In the past when fighters met man to man, it was seldom that many concentrated upon one; superiority in numbers was almost in direct proportion to the numbers themselves; the losses were about equal, under conditions equal except as to numbers, and the more numerous won on that account alone.

"Nowadays," writes Lanchester, "with firearms, the possible concentration of superior numbers gives an immediate superiority in the active combatant ranks, and the inferior force finds itself under a far heavier fire, man for man, than it is able to return."

We have made some calculations of our own based on an assumption stated very clearly by Lanchester. His statement amounts to the following: The rate of mortality in one group of fighters is directly proportional to the numbers (and to the quality) in the opposing group, and vice versa. The results of this assumption are certainly at first sight astonishing. While no one claims that battles are fought which result in an exact agreement with the calculated results, the general principle is so definite and convincing that its approximate validity cannot seriously be questioned.

Lanchester says: "There are many who will be inclined to cavil at any mathematical or semi-mathematical treatment of the present subject on the ground that, with so many unknown factors, such as the morale or leadership of the men, the unaccounted merits or demerits of the weapons, and the still more unknown 'chances of war,' it is ridiculous to pretend to calculate anything. The answer to this is simple: the direct numerical comparison of the forces engaging in conflict or available in the event of war is almost universal. It is a factor always carefully reckoned with by the various military authorities; it is discussed *ad nauseam* in the press. Yet such direct counting of forces is in itself a tacit acceptance of the applicability of mathematical principles, but confined to a special case. To accept without reserve the mere 'counting of the pieces' as of value, and to deny the more extended application of mathematical theory, is as illogical and unintelligent as to accept broadly and indiscriminately the balance and the weighing machine as instruments of precision, but to decline to permit in the latter case any allowance for the known mechanics of leverage."

Assume two groups of fighting airplanes, each group of any ability or excellence. The first group "a" in number and the second group "b" in number. We shall denote the quality of the two groups by the numbers A and B respectively. Then if x and y are variables representing the numbers in groups 1 and 2 respectively, at any time t, we may write the following equations:

$$-\frac{dx}{dt} = By \qquad -\frac{dy}{dt} = Ax \tag{1}$$

These equations assume that the rate of decrease in the num-

bers of group 1 is proportional to the surviving numbers of group 2, and the rate of decrease in the numbers of group 2 is proportional to the surviving numbers in group 1. The ability or quality of the two groups is included in the proportionality factors A and B

Differentiating once and substituting from the original equations, we obtain:

$$\frac{d^2x}{dt^2} = ABx \qquad \frac{d^2y}{dt^2} = ABy \qquad (2)$$

If we let $AB = \lambda^2$, the solution of these familiar equations may be written.

$$x = C_1 \cosh \lambda t + C_2 \sinh \lambda t$$
$$y = C_3 \cosh \lambda t + C_4 \sinh \lambda t \qquad (3)$$

It remains to evaluate the four constants of integration.

When $t = 0$ $x = a$; $t = 0$ $y = b$; so that $C_1 = a$ $C_3 = b$

Since

$$\frac{dx}{dt} = -By = C_1\lambda \sinh \lambda t + C_2\lambda \cosh \lambda t$$
$$-Bb = C_2\lambda$$

so that

$$C_2 = -\sqrt{\frac{B}{A}}\, b$$

Similarly

$$C_4 = -\sqrt{\frac{A}{B}}\, a$$

The general equations expressing the course of events then become

$$x = a \cosh \lambda t - b\sqrt{\frac{B}{A}} \sinh \lambda t \qquad (4)$$
$$y = b \cosh \lambda t - a\sqrt{\frac{A}{B}} \sinh \lambda t$$

The solutions are symmetrical functions of $\lambda = \sqrt{AB}$, hence in order to obtain results comparable on the time scale, we shall maintain constant the product AB as we vary A and B separately

We shall assume throughout that $a > b$

There are three cases of interest, namely,

$A < B$ $\qquad A = B$ $\qquad A > B$

For numerical computations let $a = 2000$ $b = 1000$

We shall keep $\lambda^2 = AB$ constant and equal to 1, in which case the general equations are

$$x = a \cosh t - Bb \sinh t$$
$$y = b \cosh t - Aa \sinh t \qquad (5)$$

CASE I

Let $A = \frac{1}{2}B$, hence because $AB = 1$, $A = .707$, $B = 1.414$

The numerical equations are

$$x = 2000 \cosh t - 1414 \sinh t$$
$$y = 1000 \cosh t - 1414 \sinh t$$

When $y = 0$, that is when the enemy squadron is completely destroyed, $\tanh t = .707$ and $t = .881$ units. For this value of t, $x = 1413$. Hence while group 2 lost 1000 machines, group 1 lost 587 although group 1 had only half the ability or quality of group 2

CASE II

Let $A = \frac{2}{3}B$ so that $A = .815$, $B = 1.224$

The equations are

$$x = 2000 \cosh t - 1224 \sinh t$$
$$y = 1000 \cosh t - 1633 \sinh t$$

When $y = 0$, $\tanh t = .6125$ and $t = .713$ units

For this value of t

$$x = 1581$$

Therefore, group 1 has totally destroyed group 2 with a loss of 419 machines only, just because of numerical superiority

CASE III

Let $A = B$, equal quality, $A = 1$, $B = 1$

For this case

$$x = 2000 \cosh t - 1000 \sinh t$$
$$y = 1000 \cosh t - 2000 \sinh t$$

When $y = 0$, $\tanh t = .500$ and $t = .55$ units

When $t = .55$

$$x = 1732$$

So that when the second group was totally destroyed, there remained 1732 machines in the first group, the net result being a loss of only 268 to the enemy's 1000

CASE IV

$A = \frac{3}{2}B$, greater numbers, better quality $A = 1.224$, $B = .815$

$$x = 2000 \cosh t - 815 \sinh t$$
$$y = 1000 \cosh t - 2450 \sinh t$$

When $y = 0$, $\tanh t = .408$ and $t = .433$ units

When t has this value

$$x = 1826$$

The first group suffered a loss of only 174 to 1000 of the second

CASE V

$A = 2B$ $\qquad A = 1.414$ $\qquad B = .707$

$$x = 2000 \cosh t - 707 \sinh t$$
$$y = 1000 \cosh t - 2828 \sinh t$$

When $y = 0$, $\tanh t = 0.353$ and $t = 0.370$ units

$$x = 1871$$

a loss of only 129 machines

The following table summarizes the foregoing results

	Group I — Initial Number 2,000					Group II. — Initial Number 1,000			
	Ability Ratio A	B	Final No.	Lost Nos.	Lost % loss	Time	Final No.	Lost	
Case I	1 to	2	1,413	587	29.4	.881	0	1,000	100%
Case II	2 to	3	1,581	419	21.0	.713	0	1,000	100%
Case III	1 to	1	1,732	268	13.4	.550	0	1,000	100%
Case IV	3 to	2	1,826	174	8.7	.433	0	1,000	100%
Case V	2 to	1	1,871	129	6.5	.370	0	1,000	100%

The curves, delineated in the accompanying figure, show how the numbers fall off in the two groups after fighting begins. The curves belonging to group A, cease to have any meaning as soon as the corresponding curve of group B reaches zero

This table shows conclusively that numerical superiority is the controlling factor in every case considered even with the quality factor against it. The first case is especially interesting in this respect where a number of machines fighting one half that number but of twice the quality win out with a loss of 30% as compared to a loss of 100% to the smaller group. With these equations it is, of course, possible to calculate the advantage to be derived by separating by superior strategy, the equally numerous enemy group into two groups, and separately annihilating them

For example a force x of 1000 meets separately a force y of 500. The result is that the 500 are destroyed with a loss of only 134 in the x force. This leaves 866 x forces opposed to 500 new y forces which can destroy with a loss to themselves of only 159 more, making a total loss in the x forces of only 293 against 1000 enemy forces

Consider two unequal groups a and b and let us deduce the relation that must exist between the quality factors A and B so that both groups lose simultaneously all of their machines, i.e., 100% loss.

The general equations give for this supposition

$$0 = b \cosh T - Aa \sinh T$$
$$0 = a \cosh T - Bb \sinh T$$

where T is the time at which this occurs and the ratio of $\frac{B}{A}$ is to be determined. By dividing one equation by the other, we get immediately

$$\frac{B}{A} = \frac{a^2}{b^2} = \left(\frac{a}{b}\right)^2$$

In other words in order to overcome a numerical superiority ratio $\frac{a}{b}$, the smaller group must have a quality better than the larger group as the square of that ratio. Specifically, to overcome a twice larger group, the quality of the smaller must be four times that of the larger. A superiority in numbers of three would require a quality superiority of nine and so on.

Lanchester's demonstration of this principle, which he calls the n^2-law is very neat and is given below. Our demonstration makes it a special case of the general integrated equations.

His assumption is that if two forces are engaged, their

relative strength is unimpaired if the same fraction of both is simultaneously put out of action, that is

$$\frac{\frac{dx}{dt}}{x} = \frac{\frac{dy}{dt}}{y}$$

which, together with

$$-\frac{dx}{dt} = By \text{ and } -\frac{dy}{dt} = Ax$$

gives immediately

$$By^2 = Ax^2$$

or, as he puts it, "the fighting strength of two opposing forces are equal when the products of the qualities by the square of the number respectively are equal"

The time T at which total destruction is completed is given by

$$\tanh T = \frac{a}{Bb} = \frac{b}{Aa}$$

Here, of course, it is necessary to know the absolute quality in order to compute specifically the time, but if the quality ratio is as stated above, both groups will eventually completely destroy each other

It is of some interest to determine what the quality ratio should be in order that when the weaker group is annihilated, the stronger shall have lost the same number of machines

The conditions for this case are, that when

$$b = T \quad x = a - b \quad y = b - b = 0$$

The equations become

$$a - b = a \cosh T - Bb \sinh T$$
$$0 = b \cosh T - Aa \sinh T$$

From the last we get

$$\tanh T = \frac{b}{Aa} = \frac{ABb}{Aa} = \frac{Bb}{a}$$

From the second

$$\frac{a - b}{a} = \cosh T - \tanh T \sinh T = \frac{\cosh^2 T - \sinh^2 T}{\cosh T} = \frac{1}{\cosh T}$$

so that $\cosh T = \frac{a}{a - b}$

Since $1 - \tanh^2 T = \frac{1}{\cosh^2 T}$ we get, calling $\frac{a}{b} = Z$ the odds,

$$\frac{B}{A} = (2Z - 1)$$

So that, if the odds are 2 to 1 against the smaller group, it will, nevertheless, inflict an equal loss on the larger group if its quality is three times that of the more numerous group; if the odds are 3 to 1, it must have a superiority of quality 5 in order to destroy an equal number of machines

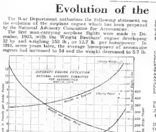
This case shows the conditions necessary where inferior machines are sacrificed for an equal number of better quality.

Although the treatment of the subject is slightly different from that of Lanchester, no claim of originality is made by the writers of this article who will feel gratified if it will attract attention to the fact so clearly brought out that "numbers" certainly do "count"

Evolution of the Airplane Engine

The War Department authorizes the following statement on the evolution of the airplane engine which has been prepared by the National Advisory Committee for Aeronautics.

The first man-carrying airplane flights were made in December, 1903, with the Wright Brothers' engine developing 12 hp and weighing 152 lb, or 12.7 lb per horsepower. In 1910, seven years later, the average horsepower of aeronautic engines had increased to 54 and the weight decreased to 5.7 lb



per horsepower. In another seven years, 1917, the average power output had advanced to 243 hp and the weight decreased to 2.8 lb. per horsepower. In March, 1918, the Liberty twelve developed 432 hp for a weight of 808 lb., or 1.86 lb. per horsepower. At the present time, May, 1918, the Liberty twelve is yielding a maximum of 450 hp for a weight of 825 lb., or 1.83 lb per horsepower

The accompanying table and curve sheet show the advance in the average power-weight ratio by years for the engines in actual flying use. It is to be especially noted that the Langley-Manly engine, built in 1901, was nine years ahead of its time in the matter of power output and sixteen years ahead in its weight per horsepower.

In 1917, the Liberty "twelve" was sixty five per cent more powerful and twenty-eight per cent lighter per horsepower than the average in service for that year. So far this year, these figures are probably changed to fifty per cent and twenty-five per cent respectively, which indicate the advance of the Liberty over the average engine in service at the present time

AIRCRAFT ENGINE EVOLUTION

Name of Engine	Year	Horse Power	Weight (lb.)	Weight per hp.
Langley-Manly Engine	1901	52	151	2.9
Original Wright Bros	1903	12	152	12.7
Improved Wright Bros	1904	16	180	11.4
Improved Wright Bros	1905	15	185	9.5
Redesigned Wright Bros	1908	35	182	5.5
Average on Market	1910	54	309	5.7
Wolseley Engine	1913	147	720	4.9
Average on Market	1914	112	437	3.9
Average on Market	1915	135	512	3.8
Average on Market	1916	185	570	3.1
Average on Market	1917	242	693	2.8
Liberty 12 cyl	1917	400	801	2.0
Liberty 12 cyl (March)	1918	432	808	1.9
Liberty 12 cyl (May)	1918	450	825	1.8

The average consumption of fuel decreased from about 8 lb per horsepower in 1903 to about .65 lb in 1914, since which it has slowly dropped to .55 lb in 1918, and, for the Liberty to .50 lb. The present Liberty consumption is approximately .46 lb per horsepower/hour.

Illustrating the advance made, the Wolseley Company in 1913, could only obtain 147 hp at 1400 revolutions per minute from eight cylinders, five in bore by seven in stroke, or 18 375 hp per cylinder. This is the same size cylinder as used in the Liberty which now gives 450 hp., at 1800 revolutions, from twelve cylinders, or 37.5 hp per cylinder obtained in the Wolseley. Even if we reduce the Liberty results to the same speed as the Wolseley, that is, 1400 revolutions, the Liberty still represents a great advance, for at that speed 350 horsepower are developed, or 29.2 hp per cylinder. Moreover, the Wolseley weighed 4.9 lb per horsepower as compared with 2.3 lb for the Liberty at the same speed, or 1400 r.p.m.

[Editor's Note—While the above statement is quite interesting, it seems rather regrettable that the engines from which the "average on the market" from 1913 to 1917 has been compiled are not specifically mentioned, for this would greatly enhance the value of this table. One might also point out that the Wolseley engine, of which such a free use is made for purposes of comparison with the Liberty engine, cannot be called a representative of its period, for it was never currently employed on any type of airplane. One is also under the impression that the geared down model of the Liberty twelve, developing 450 hp., was only an experimental type and will not be manufactured for use in service airplanes.]

The Friedrichshafen Bombing Biplane*

Forward Cockpit—This is attached to the main body by four bolts with clips similar to those earlier described It consists of a light wooden framework, covered throughout by three-ply This cockpit can be divided off from the main cockpit by means of a fabric curtain Its occupant is provided with the folding seat, and manages a gun and the bomb-dropping gear

Engine Mounting—The engine bearers have the section shown in Fig 20, and are each built up of two pieces of pine united by tongues. On their top surface they are faced with ply wood and at the bottom with ash A strip of ash applied to the upper outer corner of the bearer gives it an "L" section, and has screwed into it the threaded sockets for the set screws of the lower part of the engine fairing. The engine bearers taper sharply at each end They are mounted on the "V" struts by means of acetylene welded brackets, constructed as shown in sketch, Fig 21 These, it will be seen, are of box form, and form a liner round the streamline tube.

Fig. 20

The engine cowling is a particularly fine piece of work and two views are given in sketches 22 and 23. The lower portion is attached to the engine bearers by set screws, but the upper part is readily detachable, being furnished with turn buttons This cowling allows the cylinders of the engine to be exposed to the air A large scoop is placed in front, so as to permit a free flow of air over the bottom and sides of the crank chamber, while at the rear three large trumpet-shaped cowls are provided so that a draft of air is forced against the crankcase in the neighborhood of the carbureter air intake In the rear the fairing abuts against the propeller nave, while in front it is attached to the radiator It will be noticed that at each side of the radiator are narrow air scoops, the object of which is to promote a draft past the oil tank and front cylinder heads.

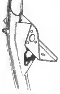


Fig 21

Engines—The engines are the standard 260 hp Mercedès, with six cylinders in line Full details of this engine have been published, and it is only, therefore, necessary to notice one or two points in connection with the installation

A new departure is the interconnection of the throttle and ignition advance controls. This is carried out in the manner illustrated diagrammatically in Fig 24 It will be seen that a considerable movement of the throttle can be made independently of the ignition advance. In the Mercédès carbureter the throttle is so arranged that it cannot be fully opened near the ground without providing too weak a mixture, and it is thought possible that the full ignition advance is not obtained until this critical opening is reached

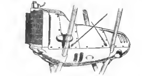


Fig 22

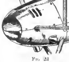


Fig 23

On several German bombing airplanes grease pumps for lubricating the water pump spindle have been found Fig 25 shows the design as fitted to the Friedrichshafen It consists of a ratchet and pawl operated grease pump, secured by a bracket to one of the engine struts and worked from the pilot's cockpit by a lever, and a stranded steel cable passing over a pulley, the pawl being returned by a long coiled spring

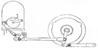


Fig 24

The engine numbers are respectively MN 32299 and MN 36228

The exhaust pipe is of new design, although it incorporates the well-known expansion joints attached to the flanges It is fitted with what amounts to a rudimentary silencer, whereas in previous machines of a similar type to the Friedrichshafen an open-ended exhaust pipe was used

Radiators—Each radiator is provided with an electric thermometer fitted into the water inlet pipe these thermometers are wired up to a dial on the dashboard, which is furnished with a switch so that the temperature of either radiator can be taken independently (Fig 26)

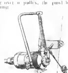


Fig 25

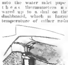


Fig 26

The honeycomb radiators are of "V" section, and each is provided with a shutter, which covers up a little more than a third of the cooling surface. This shutter is fitted with a stop so that when fully opened it lies in the line of flight of the airplane It is opened or closed according to circumstances by the gear, shown in the sketch, Fig 27, of which the handle is mounted on the root of the nacelle, immediately behind the pilot's seat Three positions are provided for the handle, which operates the two shutters simultaneously by means of return cables

Immediately above the main radiator, and let into the upper main plane between the front spar and the leading edge, is a small auxiliary tank This is furnished with a trumpet-shaped vent in the direction of the line of flight, and is furnished with two outlets, one to the head of the main radiator and the other to the water pump The function of this tank is evidently to prevent the pump from panning (Fig 28)

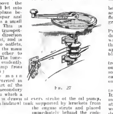


Fig 27

Oil Pump—The main supply of oil is carried in sumps forming part of the base chamber A secondary supply of oil, from which a small fresh charge is drawn at every stroke of the oil pump, is contained in a cylindrical tank supported by brackets from the engine struts and placed immediately behind the radiator This tank has a capacity of 25 liters = $5\frac{1}{2}$ gallons. Each tank is furnished with a glass level, which is visible from the pilot's seat

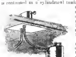


Fig 28

Gasoline Tanks—The two main tanks, which are placed one under the pilot's seat and the other at the top rear end of the nacelle, contain 270 liters = $59\frac{1}{2}$ gallons each, and are made of brass. Each is provided with a Maximall level indicator, which employs the principle of a float operating a dial by means of a cable enclosed in a system of pipes.

A hand pump is fitted convenient to the pilot, and pressure is normally provided by the pumps installed in each engine An auxiliary tank, holding approximately 13 gallons, is concealed in the upper main plane, and immediately over the nacelle but a little to the left side This auxiliary tank is fitted with a level, which is visible from the cockpit The auxiliary tank appears to be used only for starting purposes It is covered with a sheet of fabric held in position by "patent fasteners."

Engine Controls—Running from each engine to the nacelle is a horizontal streamline casing, containing the various engine controls. The leading edge consists of a steel tube, to which are welded narrow steel strip brackets, to the rear end of which are bolted thinner strips which are hinged in front to the tube The whole is then enclosed in a sheet aluminum fairing

Through the leading tube passes the throttle control rod for each engine, the two throttles being worked either together or independently by the ratchet levers, shown in Fig 29. These are mounted on a shelf convenient to the pilot's left hand This control requires a considerable number of bell cranks and countershafts, but was noticeably free from backlash The throttle is opened by the pilot pulling the levers towards him.

Fig 29

On the dashboard are two revolution counters and two air pressure indicators. The metal parts of these dials are painted red for the left engine and green for the right, and the same coloring applies to the magneto switches, one of which contains a master switch which applies to both magnetos on both engines.

Piping—The various systems of piping are distinguished by being painted different colors; thus the petrol pipes are white, arrows being also painted on them to show the direction of flow, air pressure pipes are blue and pipes for cable controls grey

Propeller—The propellers are made by the Luckenwalde Propellerwerke, Niendorf Each propeller is 3 08 meters in diameter and is made of nine laminations, which are alternately walnut and ash, except one which appears to be of maple, the last 20 in of its blade is edged with brass The pitch is approximately 1 8 meters and the maximum width of the blade 220 millimeters

Controls—Only one set of control gears is fitted, but, as pointed out, the seating accommodation is so arranged that any of the crew can take charge if and when necessary.

The elevator and aileron control is shown in sketch Fig 30 It consists of a tubular steel pillar mounted on a cranked cross bar at its foot The ailerons are worked by cables passing over a drum on the wheel, whence they descend through fiber guides on the cross bar to another wheel mounted on a countershaft below, from which they are taken along inside the leading edge of the lower wing and finally over pulleys up to the aileron levers on the top plane The latter are partially concealed in slots let into the trailing edge of the wing The upper and lower ailerons are connected by means of pin jointed tubular steel struts of streamline section.

Fig 30

It will be observed from Fig 30 that a locking device whereby the elevator control can be fixed in any desired position is fitted, and consists of a slotted link which can be clamped by a butterfly nut to the control lever This link is hinged to a small bracket attached to the panel below the pilot's seat.

Fig 31 shows the rudder control, from which cables are taken over pulleys and through housings in the nacelle and finally to the end of the fuselage The crank rudder bar is of light steel tube, and is arranged to be placed in the pivot box in either of two positions It is furnished with light steel tubular hoops, which act as heel rests and are adjustable A locking clip is fitted on the floor of the cockpit so that the rudder can be fixed in its neutral position

Fig. 31

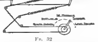


Fig. 32

A novel type of trimming gear is an interesting item of the control. Movement of the elevator control from the normal upright position of the stick is made against the tension of

one of two springs which can be alternately extended and relaxed by means of a winch connected to them, as shown in the diagram, Fig. 32. Normally these springs tend to bring the control stick back to a central position, in which the elevator lies flat, but if one of the springs is tensioned by winding up the winch in a clockwise direction, the position to which the stick will tend to come when released will be such as to set the elevator at a positive angle. This winch gear, which is illustrated in Fig. 33, is mounted on the right-hand side of the nacelle, and is therefore under the command of the pilot's companion.

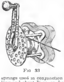


Fig. 33

The crank is furnished with a locking pawl, which engages with a ring of small holes bored in the plate of the winch. The steel springs used in conjunction with this apparatus are some 3 ft. long and about ¾ in. in diameter. The inscription behind the winch reads:

Nose heavy—Right wind.
Tail heavy—Left wind.

Landing Gear—As might be expected, the landing gear on this machine is of massive proportions. Two vertical streamline section wood-filled tubes descend from the center section wing spars, immediately under the engine, to a bridge piece or hollow girder made of welded steel. This is shown in Fig. 34. Through an oval hole in this girder a short axle carries two

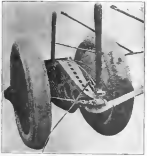


Fig. 34. Main Wheels with Fabric Fairing Removed

965 × 150 mm. wheels (38 in. × 6 in.). These work up and down against the tension of a bundle of steel springs about ½ in. in diameter and made of wire approximately 1/8 in. thick. The steel girder is extensively pierced for lightness, and the edges of the holes are swaged inwards. The axle is prevented from moving sideways by plates, and is provided with short steel cables which act as radius rods and connect it to the front of the girder. The whole of the box girder is covered in with a detachable bag of fabric, which extends up to the small cross bar mounted immediately above the girder.

Mudguards are provided behind each landing wheel for the purpose of preventing any mud or stones dislodged by the wheels from coming in contact with the propellers.

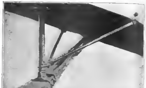


Fig. 35. Tail Skid

From the front and rear of the box girder streamline tubes are taken to the ends of the main wing spars, where they abut against the nacelle, and these diagonals are further braced with streamline steel tubes. Both the vertical and diagonal tubes are held in split sockets so as to be easily replaceable if damaged.

In addition to the four main landing wheels a fifth is mounted under the nose of the fuselage. This wheel is 760 mm. × 100 mm. (30 in. × 4 in.). It is mounted on a short tubular axle, which is capable of sliding up and down slots in its forks against a strong coil spring, and it is also capable of a certain amount of lateral movement along its axle, also against the action of two small coil springs.

The tail portion of the body is protected by a fixed skid made of wood but shod with a steel sole. This is arranged as shown in photograph Fig. 35, and is fitted with a small coil spring contained inside the body.

Wiring—The whole of the wiring system on the machine is very neatly carried out. There are three main systems: firstly, the ignition wiring, which is contained for the most part in tubes of glazed and woven fabric; secondly, the heating system, for which the wires are carried in flexible metal conduits, and, thirdly, the lighting system, in which a thin celluloid protective tubing is used. Wires are run from the nacelle along the leading edge of the upper planes to points level with the outermost strut. Here they terminate in a plug fitting placed behind a hinged panel. Apparently lamps are intended to be served by this circuit. Immediately in front of the pilot's seat a universally jointed lamp bracket is mounted on the outside of the nacelle. The exact purpose of this lamp is not known, as it could not illuminate any instruments.

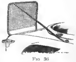


Fig. 36

Armament—Both the forward and rear cockpits are furnished with swivel gun mounts carrying Parabellum machine guns. These mounts consist of built-up laminated wood turntables working on small rollers, and carry a U-shaped tubular arm for elevation. This arm is hinged to a plunger rod working through a cross head, and arranged so that the arm is normally pulled down flat on the turntable by a coil spring. The plunger can be locked in any of a series of positions by means of a bolt operated by a hand-lever through a Bowden wire. A second lever allows the turntable to be locked at any desired point. A perforated sheet-metal shield protects the cross head and spring. Small shoulder pads are fixed on the turntables, of which that in the forward cockpit has a diameter of 2 ft. 10½ in., whilst in the rear the diameter is 3 ft. 0½ in.

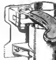


Fig. 37

The after gunner is prevented from damaging the propellers by two wire netting screens supported by tubular steel brackets, placed on either side of his cockpit. (Fig. 36.)

In addition to these two guns, provision is made for mounting a third in front of, and to the right of, the pilot's cockpit, where it could be managed by his companion. For this purpose a clip is provided immediately under the coaming of the nacelle, and the handle of this protrudes through a slot in the dashboard. The clip works on the eccentric principle, and appears to be self-locking. Its construction is shown in detail in Fig. 37.

A rack for Verey lights is mounted on the outside of the nacelle, convenient to the pilot's companion.

Airspeed Indicator—Considerable interest attaches to the fact that this Friedrichshafen bomber is the first enemy machine brought down which has been found provided with an airspeed indicator. This is of the static type, embodying a Pitot head of the usual type. The indicator has a dial of large size, and is altogether a much more bulky instrument than any of a similar purpose used on British machines. An investigation of its mechanism is being made.

Altimeter—This is of the usual type, reading to 8 kilometers.

Level Indicator—This is a somewhat crudely made device, employing two liquid levels. The reading gives the pilot an exaggerated idea of the angle of roll. The glass tubes are sealed up, and contain a dark blue liquid.

Revolution Counters—The dials give readings from 300 to 1,600 r.p.m. The sector between 1,300 and 1,500 is painted black, and these figures are marked with luminous compound, as also is the indicating hand. The manufacturer is Wilhelm Morell, Leipzig.

Air Pressure Gauges—These read from 0 to 0.5 kilograms per square centimeter. There is a red mark against the figure 0.25 kg. The manufacturer is Maximall Apparate Fabrik, Berlin.

Electric Thermometer Dial—This dashboard instrument consists of a box-type meter, the dial reading from 0 to 100° C. The figures 0 and 75 are accentuated by red marks. A switch at the side of the box, having positions marked 1 and 2, allows the temperature of either radiator to be read.

Petrol Level Indicators—These are of the Maximall type, and employ a float immersed in a tubular guide in the tank. This float communicates its motion to a finger working over a circular dial, by means of a thin cord passing over pulleys. These are encased in pipes which are under the same pressure as the tank.

Electric Heating Rheostat—This is marked Aus (off), Schwach (weak), Stark (strong). There are two separate resistance coils, enabling the rheostat also to perform the function of a change over switch.

Wireless—The machine is internally wired for wireless, and the left-hand engine is provided with a pulley and clutch for driving the dynamo. Reference to Fig. 22 will show that this is designed to be mounted on a bracket carried by the outside front engine bearer strut, and that the engine fairing is molded to receive it.

Bombs and Bomb Gear—At each side of the covered-in passage-way in the nacelle are bomb racks, capable of holding five 25-pounder (12 kg.) bombs. Underneath the nacelle are carried two large tubular frames, fitted with cradles of steel cable and furnished with the usual form of trip gear. These racks would, it is believed, be capable of supporting a 300 kg. bomb apiece. The bombs carried, however, evidently vary with the radius of action over which the airplane has to operate.

It is from the inside of the front cockpit that the release of the bombs is conducted. There are seven triggers for the small bomb racks and two levers for the large bomb trips. The cables for this gear are carried under the floor, and are painted different colors for distinction.

Fabric and Dope—Two entirely different kinds of fabric are employed in the Friedrichshafen machine. The wings are covered with a low-grade linen of the class which is employed on most of the enemy machines. It is white in color. Compared with that of British fabrics, the tensile strength is fairly good.

The other fabric, which is applied to the body, tail planes, rudder, elevator, fin and landing gear, is apparently a cheap material much inferior to British fabrics designed for a similar purpose. This body fabric is dyed in a regular pattern of lozenges, the colors being hardly distinguishable from black. The dope is acetate of cellulose.

In both cases the dope seems to be carelessly applied.

Three-Quarter Front View of the Friedrichshafen Bomber
Courtesy of the N. Y. World

The Model M.T.2 Lawson Biplane

Consideration was given in this machine mainly to obtain sturdiness, manoeuvering ability and vision. It can also be used for primary gun work, since the rear seat is so situated as to allow mounting of guns on the rear pit rim and on top of the cabane. Care was also taken in streamlining all parts possible and this has been accomplished to such an extent that the mahogany veneer forms the nose of the upper surface of both wings while false ribs are placed between the standard ribs from the spruce entering edge to the front spars.

Between spars the ribs are braced by stringers while the bays are separated by square section spruce struts channeled out.

THREE-QUARTER FRONT VIEW

usual trouble found in removing parts required for inspection is entirely dispensed with.

The characteristics of the M.T.2 are approximately the following:

Span, upper plane	36 ft.
Span, lower plane	30 ft.
Chord	5 ft. 4 in.
Gap	5 ft. 1 in.
Stagger	8 in.
Incidence	3 deg.
Dihedral	1 deg.
Area, upper plane (including ailerons)	200 sq. ft.
Area, lower plane	150 sq. ft.
Length, overall	25 ft.
Height, overall	8 ft.
Weight, empty	1,200 lbs.
Weight, loaded	1,900 lbs.
Speed range	40–90 M.P.H.
Climb in 10 minutes	6,000 ft.
Gliding angle, full load	1 in 9
Engine, Hall-Scott	100 H.P.

Planes

Both wings are in two sections, the top attaching by hinges to hinge plugs secured in the cabane and the lower to plugs secured to fittings and cross tie tubes in the body.

The spars are of I section spruce and are left solid at both internal and external strut attaching points and also wherever any bolts attach such as for the wing and aileron hinges. The ribs are built of basswood webs, reinforced with fibre strips between lightening holes, and spruce cap strips. Two ply

Double wiring takes all drift strains while single wiring is used for truing up.

The trailing edge is ash, excepting at the inner ends of the wings and outer ends of the ailerons where flattened steel tubing is used. The outer edges are of steam bent white ash and slightly curved in plan view to take the tensional pull of the cloth caused through the contraction of the wing dope upon its application.

The lower wing is provided with handholds and running boards alongside the body.

Both wings are connected by two pairs of interplane struts on each side of the body. These are of solid spruce and taper into cup sockets which are fastened to the wing strut plates by a neat bolt and nut. The plates themselves are of the four bolt type whereupon the bolts clamp the spars and are prevented from sliding by blocks attached to the latter.

The lift cables are all doubled and are all of ⅛ in. cable with the exception of the main lift and main landing wires, these being 5/32 in.

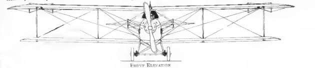
The ailerons, fitted to the upper wing only, have a total area of 40 sq. ft. and work in conjunction with each other, being interconnected by cable guided through fairleads on top of the upper wing. Each is equipped with two sets of brace arms provided with shackles to take both brace and control cables. The control cables run through pulleys down to the

THREE-QUARTER REAR VIEW

body where they connect to a chain and are secured to each other as well.

The cabane is entirely of steel. The legs are of streamline section welded directly to the connecting tube and further braced by corner plates. On the lower ends of the legs are

M.T.2 is equipped with the usual complement of instruments, including respirators for altitude work, and may also be equipped with the Lawson Detachable Heating Arrangement, and alongside of each seat are Pyrenes connected to tubes running forward to the motor section, which may thus be



FRONT ELEVATION

resting plates which are so made to prevent any sliding and to also locate easily upon assembly. To carry the wings, bushings are welded in through each end of the connecting tube, which are provided to take the main landing wire terminals as well as the wing hinge plugs. Both front and rear ends of this tube are capped with streamline nose and tail pieces. The front legs of the cabane also carry the radiator bed plate.

Body

The longerons and vertical struts are of ash in front and spruce in the rear. The longerons are left solid their complete length while all struts, both vertical and horizontal, have been channeled but left solid at all points of connection. Steel tubes fitted into sockets are used for horizontal struts back to the rear pit and also to carry the load from the tail skid shock absorbers.

Owing to the constant section of both longerons and struts in the rear part of the body, all fittings are interchangeable. The stern post is of tubing with interchangeable fittings at upper and lower ends to take the longerons. Each pit is reinforced with ash rims as well as the tension wires to prevent any twisting effect caused by rapid manoeuvering either on the ground or in the air and it likewise acts as a protection in case of a "telescoping" landing. The whole body is braced throughout by double cables in the front sections and wire in the rear.

The engine bed rails rest on top of an ash cross member and are secured to this by U-bolts. The whole unit is braced by tubes fitted with plug ends which bolt directly to the bed and body fittings in such a manner as to entirely eliminate all wire bracing.

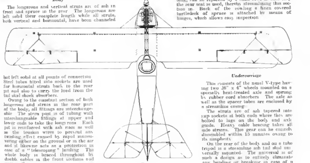
Dual control is used while either are made demountable for any purpose intended. The lower ends of the control columns are connected to a main rocker shaft, mounted in large bearings on the floor. Directly under the front seat a sector with two grooves is mounted which carries two chains connecting to the aileron control cables.

Just in back of the rear pit and mounted on the seat rails is a cross rocker shaft which is equipped with a cantilever lever connecting to the rear control, by means of a universal joint, and two elevator rocker levers to which the control cables are secured by a universal attachment.

flooded around the carburetors and gas tank in case of fire.

In front of the front pit and on top of the longerons a gas tank holding two hours' fuel is mounted.

The nose of the body is covered with an aluminum cowling which is slightly oval in form and is provided with air holes and inspection doors. The deck cowling is made in three sections. The first can be detached for inspection of the gas tank, while the second, which carries the pit padding, can be replaced by a solid cowl in case only the rear seat is used, therein streamlining this section in. Back of the cowling a linen covered turtledeck of spruce is attached by means of hinges, which allows easy inspection.



PLAN

Undercarriage

This consists of the usual V-type having two 26" x 4" wheels mounted on a specially heat-treated axle and sprung by rubber cord absorbers. The axle as well as the spacer tubes are enclosed by a streamline casing.

The struts are of ash tapered into cup sockets at both ends where they are bolted to lugs on the body and axle guide. Heavy cable bracing takes all side strains. This gear can be entirely dissembled within 15 minutes owing to its simplicity.

On the rear of the body and on a tube tripod is a streamline ash tail skid universally mounted. The universal is of such a design as to entirely eliminate any bending or breaking in case of a side-swipe. By removing three bolts the entire tripod and skid are removable in case of a replacement.

Tail Group

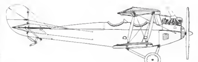
This unit is constructed mostly of steel, the outer edges in all cases being entirely of tubing either left round or flattened. The stabilizer is of the double cambered type and is entirely of spruce framework with the exception of the edge. Two spars braced by box ribs and wire take all internal loads while the whole unit is carried below by streamlined tubes and above by cable running from the fin tube.

The stabilizer is set at a negative angle of two degrees and measures 35" x 10' 6".

The fin is entirely of tubing welded together. This surface is 34" high and the same width as the stabilizer.

To both of these surfaces are hinged the elevators and rudder respectively. The former are built up of pressed steel ribs of channel section and lightened. These are 28¼" wide and give a total span to the tail of 12' 10½". The rudder is 4' 9" high and 35 7/16" wide, non-balanced and constructed most of ash and spruce.

This machine as constructed at present is equipped with the Hall-Scott engine A 7A model, driving an 8' 0" propeller. However, being built for interchangeability it can be equipped with a 200 hp. motor, and adapted for fighting purposes.

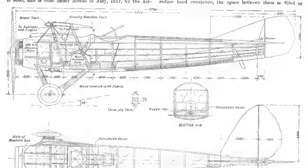


Side Elevation

The Spad Two-Seater Fighter

The following particulars and illustrations, apparently from an official German report on the Spad two-seater, are published in *Flugsport* of April 10 and reproduced here from *Flight*.

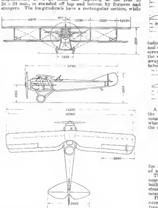
The Spad two-seater, which is herewith described, is marked B 6006, and is built under license in July, 1917, by the Aircraft Works of Ad Bernard in La Courneuve (Seine). In general design and in constructional details it resembles the single-seaters, but does not have the divided inner interplane struts usually found on these. It is built as an ordinary two-strutter. The spars of the lower wings are braced to the under-carriage from the point of attachment of the inner pair of struts. The upper wing, which runs right through, has a span of 11.22 m., and a chord of 1.53 m., while the lower wing has a span of 10.90 m. and a chord of 1.43 m. The gap is 1.335 m. and the stagger 0.4 m. There is no dihedral angle, but both upper and lower wings are swept back, the angle being 174 deg. In order to give a better view, the lower wings have been cut away near the body, and the upper wing has a cut-out portion in the center. The two spars are placed closer together than those of the lower wing, and the inter plane struts converge somewhat upwards. The angle of incidence of the upper plane is 2.8 deg. in the center, and 2.5 deg. at the tip, while the lower plane has a uniform angle of 1.5 deg. The lift wires are in duplicate, and in order to reduce head resistance, the space between them is filled up with strips of wood. The landing wires are single. A drift cable runs, from the junction of the inner interplane strut to the upper front spar, to the point of attachment of the front under-carriage strut. The interplane struts, which are of streamline section, are made of wood. Their fittings are attached to a steel tube carried inside the strut.



The spacing of the ribs is 190 mm. in the top wing and 175 mm. in the lower wing. Between the ribs there are false ribs on the upper surface running from leading edge to front spar. The fabric is tacked to some more strongly constructed ribs, and is, in addition, stitched to ribs and to the wire forming the trailing edge. On the under surface, near the trailing edge, there are eyelets which serve to equalize the pressure and to drain any moisture out of the wing. Wing and body covering are painted a yellowish white.

Non-balanced ailerons are hinged to false spars in the upper plane. They are operated by means of pull and push rods which rest in the lower plane behind the rear spars, and the movement of which is transmitted through cranks at the lower ends of the outer struts, to vertical struts pivoted to the lower surface of the aileron.

The body, which is of the usual construction, with four longitudinals, 28 x 28 mm., and tapering at the rear to 24 x 24 mm., is rounded off top and bottom by formers and stringers. The longitudinals have a rectangular section, while the vertical and horizontal body struts are spindled out to an I section, and are reinforced by plywood. A trap-door in the floor behind the observer's cockpit provides access to the interior of the body.

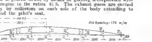


Front Elevation, Side Elevation, and Plan

The stabilizing and control surfaces are of the usual Spad type. The tail plane, which runs right across the body, and has both sides cambered, is attached to the upper longitudinal at an angle of incidence of 0 deg. To its trailing edge, the divided elevator is hinged by means of a steel tube. In order to reduce resistance, the cranks are placed in the center inside the body and vertical fin.

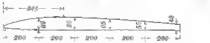
The machine is provided with dual control. For operating the ailerons, the movement of the control shaft is transmitted by means of a lever, to a rocker supported in a partition between pilot's and observer's cockpits. The rods—which rest in the bottom wing—engage with a downward projection of this rocker. The observer's control lever is in the form of a telescopic tube, whose upper part is forced upwards by a spiral spring, or pressed down when not in use, and held in position by a bayonet joint. When extended, its length measured from the pivoting point is 53 cm., and when telescoped it measures 36 cm. The rudder bar in the observer's cockpit can be covered over with detachable covers, to guard against accidental use. The V form under-carriage struts are made up of several layers of wood glued together, and the whole covered with fabric. Diagonal bracing is employed in both front and rear bays. The two stub axles rest between two cross tubes covered with fabric, and move in slots in the struts. The travel is 125 mm. The VEE type Hispano-Suiza engine, which develops about 200 hp. at 2,000 r.p.m., rests on engine bearers which are connected up to the body longitudinals by means of transverse supports of three-ply wood, and angle pieces pressed out of aluminum. The two-bladed air screw is geared down, by means of gearing incorporated with the engine in the ratio 4:3. The exhaust gases are carried away by collectors on each side of the body extending to behind the pilot's seat.

Section of Upper Wing



Section of Lower Wing

A pressure petrol tank with a capacity of 140 liters forms the pilot's seat, while a gravity tank holding 10 liters is mounted in the upper wing, between the spars. The oil tank, which holds 15 liters, rests on the floor of the body behind the engine. The bottom of the oil tank has pressed on it ribs for cooling the oil. The fuel capacity is sufficient for a flight of about 2 hours' duration.



Section of Tail Plane

The radiator, which is provided with shutters, forms the nose of the body. A reservoir connected with the radiator is built into the upper wing in front of the front spar. Any steam or excess water is carried off underneath the body by means of an overflow and a pipe.

The pilot's seat, which as in all Spad airplanes is kept very narrow, is separated from the engine by a linen curtain. In front of it is a wind screen divided into three parts and framed in aluminum.

In the observer's seat are, in addition to the dual controls, two switches, one gas lever, and one lever for regulating the mixture, so that, apart from the gasoline controls, the observer can look after the engine. Wireless installation is not fitted, although antennae wires are provided in the body.

The armament consists of a fixed Vickers machine gun mounted above the body, for the pilot. The gun is operated by a push-rod from the right hand cam shaft. The trigger is on the control lever. The observer is armed with two Lewis machine guns coupled together. Six ammunition drums can be carried in the observer's cockpit, suitable brackets being provided.

The weight of the machine empty, but including the cooling water, was ascertained to be 765 kg. A notice on the rudder gives the useful load (poids utile) as 255 kg. and the fuel weight (poids combustible) as 120 kg. This gives a total weight of 1,140 kg.

Item Weights	Kg.
Engine	225.0
Cooling water	32.0
Wings	167.0
Elevator and rudder	19.0
Body, etc.	319.2
	765

Loading	Kg.
Pilot and observer	170.0
Armament	81.5
Instruments, etc.	3.5
Fuel	120.0
	375

Unit weight of wings 167.0/29.5 = 5.64 kg./sq. m.

Lawson

Second Lawson Aircraft Factory, December, 1917

M. T. 1
M. T. 2

Third Lawson Aircraft Factory, April, 1918

First Lawson Aircraft Factory, April, 1917

The Lawson Aircraft Corporation
Green Bay, Wisconsin

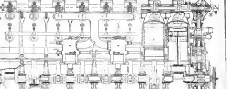
The 240 hp., 8-cylinder Mercédès Engine

The following detailed report on the design of the 8-cylinder Mercédès engine, which has been issued by the British Air Ministry, is based on an investigation of the engine (No 23 003) taken from the German two-seater Albatros Biplane (G 37) which was brought down by anti-aircraft guns near Armentières on May 12, 1917 This engine has been tested at the Royal Aircraft Factory and results of B H P developed, gasoline and oil consumption, etc, during tests are given herewith, together with details of the engine design and the leading particulars of the engine Although this engine, according to reports, is now obsolete, the design having been abandoned in favor of the German standard six-cylinder vertical type, details and illustrations of the engine will no doubt prove of considerable interest, more particularly to those interested in the design of the special engines used for airship work.

Lubrication system, forced, multiple plunger pumps, oil temperature, 37.5° C (test figures), oil consumption per hour, 10.16 pints = 11.43 lbs., oil consumption per B.H.P. hour, 0.042 pint = 0.047 lb, specific gravity of oil, 0.900

Type of carburetors, two, Mercédès, twin-jet, diameter of chokes, 0.945 in. = 24 mm.; bore of main jets, 0.078 in. = 2 mm., bore of pilot jets 0.0197 in = 0.5 mm. Fuel consumption per hour, 141.3 pints = 127.1 lb. Fuel consumption per B.H.P. hour, 0.582 pint = 0.524 lb.; specific gravity of fuel, 0.720, inside diameter of induction pipes, 2.125 in = 54 mm.

Type of magnetos, two Bosch H.L.8. Firing sequence of engine, propeller, 1-3-2-4-8-6-7-5. speed of magnetos, engine speed, magneto timing in degrees early full advance, 30° early



General Arrangement of the Engine

In its general details this engine follows closely the design of the 160 hp. Mercédès engine as regards the construction of the cylinders, pistons, valve gear, etc, and also in the lubrication system. It is therefore very similar to the 160 hp engine, with an extra pair of standard cylinders and a massive propeller shaft reduction gear, and the necessary alterations to the design of the crankshaft and the induction system.

Engine Data

Number and arrangement of cylinders, eight, vertical separate; bore 5.51 in. = 140 mm., stroke 6.30 in. = 160 mm., stroke/bore ratio 1.142 : 1; area of one piston 23.84 sq. in. = 153.9 sq. cm., total piston area of engine 190.83 sq. in. = 1231 sq. cm.; stroke volume of one cylinder, 150.28 cu. in. = 2463 cu. cm. Total stroke volume of engine 1202.24 cu. in. = 19704 cu. cm. volume of clearance space, 40.30 cu. in. = 660 cu. cm. Total volume, clearance volume, 4.73 : 1

Nor. B H P and speed, 287 B H P at 1750 r.p.m.; Normal B H P and speed 242 B H P at 1350 r.p.m., Piston speed at normal speed 1418 ft. per min., brake mean pressure at normal speed, 118 lb. sq. in.; cu. in. of stroke volume per B H P, 4.97 cu. in. Sq. in. of piston area per B H P, 0.788 sq. in.; B H P per cu. ft. of stroke volume, 348.0, B H P per sq. ft. of piston area, 182.7

Direction of rotation of crank, anti-clockwise, facing propeller, direction of rotation of propeller, left hand tractor, normal speed of propeller, 977 r.p.m., ratio of crankshaft speed to propeller speed, 1.382 : 1; type of gear reduction to propeller, Spur gear

Inlet valve opens. Degrees on crank, 2° late. Inlet valve closes. Degrees on crank, 51° late. Diameter of inlet valve (smallest diam) = d, 2.677 in. = 68 mm.; Lift of inlet valve = h, 0.450 in. = 11.4 mm. Area of inlet valve opening (πdh), 3.780 sq. in. = 24.40 sq. cm. Mean gas velocity through inlet valve at normal speed, 149.5 ft. per sec.; clearance of inlet tappet, 0.012 in. = 0.305 mm

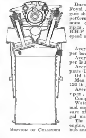
Exhaust valve opens. Degrees on crank, 52° early. Exhaust valve closes. Degrees on crank, 16.5° late, diameter of exhaust valve (smallest diam) = d, 2.677 in. = 68 mm., lift of exhaust valve = h, 0.412 in. = 10.48 mm.; area of exhaust valve opening (πdh), 3.460 sq. in. = 22.4 sq. cm.; clearance of exhaust tappet, 0.018 in. = 0.457 mm

Weight of engine complete, without water, fuel or oil, 900 lb (including exh. manifold and propeller hub); weight per B.H.P., 900/242 = 3.72 lb per B H P, weight of exhaust manifold, 19.5 lb, weight of oil carried in engine, 17 pints = 19.13 lb, weight of fuel per hour, 127.1 lb, weight of oil per hour, 11.44 lb, total weight of fuel and oil per hour, 138.5 lb, gross weight of engine in running order, less fuel and oil, 1057 lb (including cooling system, 242 × 0.65 lb), weight per B.H.P., 1057/242 = 4.37 lb. per B H P, gross weight of engine in running order with fuel and oil for six hours, 1971 lb (tanks at 10 per cent of weight of fuel and oil), weight per B.H.P., 1971/242, 8.15 lb per B.H.P.

Delivery of water pump at 1350 r.p.m. of engine, 91 gal. per min; water jacket capacity of one cylinder, 1280 cu. cm.; ratio of water pump speed to crankshaft speed, 1.5 : 1, water temperatures at inlet, 65° C Water temperature at outlet, 78° C, diameter of water pump inlet and outlet, 1.37 in. = 35 mm

General Analysis of Weights

Description of Part.	No. Per Set.	Av Unit Weight in Lb	Weight of Complete Set in Lb	Percent. of Total Weight.
Cylinders (bare)	8	19.25	154.00	17.111
Pistons complete with rings and gudgeon pins	8	6.35	54.40	6.088
Connecting rods complete with floating bushes	8	5.00	40.00	4.444
Valves, inlet and exhaust complete	16	1.812	20.992	2.332
Crankshaft, with floating bevel gear	1	94.50	94.50	10.500
Camshaft and case with half compression gear	1	60.00	60.00	6.666
Reduction gear (large) with propeller shaft and bearings complete	1	45.00	45.00	5.000
Reduction driving gear on cam shaft, complete with bearings and thrust race	1	23.25	23.25	2.583
Base chamber (top half)	1	103.76	103.76	11.527
Base chamber (bottom half)	1	113.00	113.00	12.555
Carburetors, complete	2	8.00	16.00	1.777
Induction pipes, complete	2	7.25	14.50	1.611
Oil pump, complete	1	12.50	12.50	1.388
Water pump, complete	1	9.00	9.00	1.000
Vertical driving shaft, including magneto driving bevels and couplings etc	1	12.50	12.870	1.430
Propeller hub complete	1	17.875	17.875	1.986
Magnetos	2	17.25	34.50	3.822
Ignition wiring complete	2	2.50	5.00	.555
Exhaust manifold	1	19.5	19.5	2.166
Miscellaneous parts			48.958	5.439
Total weight of complete engine			900.00	100



Section of Cylinder

During calibration tests at the Royal Aircraft Factory, the engine showed a very good general performance, developing a maximum of 286 B.H.P. at 1750 r.p.m., and an average of 242 B.H.P. at a normal crankshaft speed of 1350 r.p.m.

Summary of Test

Average gasoline consumption per hour, 141.3 pints

Average gasoline consumption per B H P hour, .582 pints

Average oil consumption, .042 pints/B H P. hour

Oil temperature, 37½° C

Mea. B M E P at 1110 r.p.m., 120 lb./sq. in.

Average B.M.E.P. at 1350 r.p.m., 118 lb./sq. in.

Compression ratio, 4.73 : 1

Water pump delivery at normal engine revs against a pressure of 2 lb. per sq. in. = 91 gal. min

The total weight of complete engine, dry, including propeller hub and exhaust manifold = 900 lb., equivalent to 3.72 lb. per B.H.P. An attempt was made to throttle the engine below 900 r.p.m., but the running was irregular.

During a power and consumption run of one hour's duration an average of 267 B H P. was developed, at an average speed of 1550 r.p.m., and at an average gasoline consumption of 155 pints per hour = .582 pints per B H P. hour

Albatros Biplane Fitted with an 8-Cylinder Mercedes—the Reduction Gear is Clearly Visible, as is the Cut-away of the Air Screw, so Shaped to Allow for the Nose Fairing

Oil consumption = 10.10 pints per hour = .042 pints per B H P. hour

Water temperature, inlet = 65° C ; outlet = 78° C

This test should not, however, be taken as representing the normal performance of the engine, as the average speed at which it was run, namely, 1550 r.p.m., is higher than that which would be obtained for any length of time in the air.

Machine Guns for American Aircraft

The Browning machine gun has successfully undergone a test to determine its value for use with aircraft. This is one of three types of machine guns with which the rate of fire can be so synchronized with the revolutions of the propeller of a tractor airplane that the gun can be fired by the pilot of a combat plane through the revolving blades Firing in that fashion, it is necessary to aim the machine gun by steering the plane directly at the target The direction of the plane gives direction to the fire, and the pilot can fire the machine gun while controlling the plane.

Airplane propellers revolve at from 800 to 2000 r.p.m. The machine gun is connected with the airplane engine by a mechanical or hydraulic device, and impulses from the crankshaft are transmitted to the machine gun. The rate of fire of the machine gun is constant, and its fire is synchronized with the revolving propeller blades by "wasting" a certain percentage of the impulses it receives from the airplane engine and by having the remaining impulses trip or pull the trigger so that the gun fires just at the fraction of the second when the propeller blades are clear of the line of fire

The pilot operates the gun by means of a lever which controls the circuit and allows the impulses to trip the trigger

The test given the Browning gun was severe. A gun was mounted on the frame of an American combat plane and connected with the airplane engine. The test was conducted on the ground, and in place of the propeller a metal disk was attached to the crankshaft The Browning gun was then required to register hits on the metal disk as it revolved at varying speeds from 400 to 2000 r.p.m. The slightest "hang fire" or delay in action on the part of the gun would have been shown by the failure of the bullets to hit precisely on the spot on the disk representing the center of the zone of fire The gun functioned perfectly

The Browning gun to be used with aircraft is the heavy type with the water jacket removed

Besides the Browning, the United States will also employ the Marlin Aircraft gun as a synchronized weapon. Several thousand of these have been manufactured and the gun is in quantity production

The Lewis Aircraft machine gun is used by the British, French and American forces, but for a different purpose. In a two-seated combat plane, fixed machine guns are mounted forward to be operated by the pilot, and flexible guns are mounted to be operated by the observer in the rear seat of the plane. The observer operates Lewis guns on flexible mounts, firing to right or left of the plane

The C.V Model L.V.G. Biplane*

The model C V L.V G biplane belongs, as its serial letter indicates, to the all-purpose class of airplanes The model here reviewed was built by the Luft-Verkehrs Gesellschaft

The principal characteristics of the model C V L V G biplane and of the preceding types of this make as well as of the model C IV Rumpler biplane† may be gathered from the following comparative tables

The lower plane is similar in outlay to those used on the D F W, the Rumpler C IV, and the Albatros C IV, namely, the tips are rounded off to a greater extent at the trailing edge than at the leading edge (This is incidentally the classic Blériot wing shape, which is nowadays still employed on the British B E airplanes.—*Ed*)

The chord of the upper plane is 1.74 m, that of the lower

Front Elevation

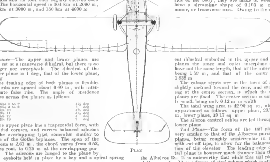
Table I Comparative Table of the Various L V G Biplanes

	C II	C IV	C V
Span (upper)	12 85 m.	13 60 m	13 62 m.
Span (lower)	11 35 m.	12 00 m.	12 85 m
Overall length	8 10 m.	8 60 m.	8 10 m
Overall height	3 00 m.	3 10 m.	3 20 m.
Wing area	37 65 sq. m.	40 00 sq m.	42 70 sq m.
Weight empty	845 kg.	900 kg	920 kg.
Horsepower	175	235	225
Engine	Mercédès	Mercédès	Benz

Table II Comparative Table of the Model C V L V G and the Model C IV Rumpler Biplanes

	Rumpler	L V G
Span (upper)	12 60 m	13 62 m.
Span (lower)	12 10 m	12 85 m.
Overall length	8 40 m	8 10 m.
Overall height	3 25 m	3 20 m.
Wing area	33 50 sq m	42 70 sq m.
Weight empty	1010 kg	1066 kg
Horsepower	260 or 250	225
Engine	Mercédès or Maybach	Benz

The model C V L.V G biplane has an all around poorer performance than the Rumpler C IV, its climbing speed is 4000 m in 35 minutes and its roof only slightly exceeds 5000 m. The horizontal speed is 164 km at 2000 m, 160 km at 3000 m, and 150 km at 4000 m



Plan

Planes—The upper and lower planes are both set at a transverse dihedral, but there is no stagger nor sweepback The dihedral of the upper plane is 1 deg, that of the lower plane, 2 deg

The trailing edge of both planes is flexible. The ribs are spaced about 0 40 m, with intermediate false ribs. The angle of incidence varies across the planes as follows

Ribs 1 to 2	4½ deg
Ribs 3 to 8	5 deg
Rib 10	4½ deg
Rib 11	4½ deg
Rib 12	4 deg
Rib 13	3 deg

The upper plane has a trapezoidal form, with rounded corners, and carries balanced ailerons of the overlapping type, somewhat similar to those of the Gotha biplanes. The span of the ailerons is 2.61 m, the chord varies from 0 53, at the root, to 0 75 m at the overlapping portion. The ailerons are hinged to the plane by Q D eyebolts held in place by a key and a spiral spring

plane, 1 59 m. The gap is 1 74 m at the body, and 1 66 m at the outer interplane struts.

Two pairs of the latter are carried on either side of the body, they are made of wood and have a streamline shape of 0 105 m in the minor, or transverse axis. Owing to the different dihedral embodied in the upper and lower planes the inner and outer interplane struts have not the same length, that of the inner pairs being 1 59 m, and that of the outer pairs 1 635 m

The cabane struts are in the form of an N, slightly inclined toward the rear, and converging at the center section, to which the upper planes are fixed The center section is unusually small, being only 0 12 m in width

The total wing area is 42 90 sq m, which is apportioned as follows upper plane, 23.73 sq. m, lower plane, 19 17 sq m

The aileron control cables are led through the lower plane

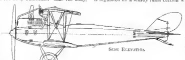
Tail Plane—The form of the tail plane is very similar to that of the Albatros pursuit biplanes, being roughly semicircular in shape, with cut-off tips, to allow for the balanced portion of the elevator The leading edge of the tail plane is however much thinner than that of the Albatros D It is noteworthy that while this tail plane is cloth covered and has a frame of steel tubing which is attached to the body in the conventional manner, the vertical fin is built up out of the body and is plated with three-ply wood

* Translated from *L'Aérophile*
† Described in the March 18 1918, issue of Aviation and Aeronautical Engineering

Elevator—This is of the balanced type, with overlapping triangular portions fitting into the cut-out provided on the tail plane The overall span is 3 04 m, and the maximum chord, 0.65 m The triangular portions have a base of 0 39 m. and a height of 0.39 m The edges of the tail plane are reinforced to prevent vibration

Vertical Fin and Rudder—The vertical fin is, as has been said before made integral with the body, that is, its frame is simply an excrescence of the body bulkheads. Like the body, the vertical fin is covered with veneer, but the rudder, which is balanced in a manner similar to that of the elevator, has a frame of steel tubing, and is covered with fabric

The overall height of the rudder is 1 068 m., its depth is 1 15 m, including the balanced portion The fin is reinforced on the edges like the tail plane The control cables run partly within the body and also within the tail plane



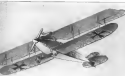
Side Elevation

Body—The body is of approximately rectangular cross-section with a turtle back and slightly rounded under face. It is built up of bulkheads and is covered with highly polished three-ply wood

Q D Bolt Used in the Aileron Hinges

The pilot cockpit is situated next to the engine and is of oval shape, with the major axis in the longitudinal axis of the machine A synchronized Spandau machine gun is fitted to the right of the engine, it is operated by a Bowden cable.

The after cockpit is very close to the pilot cockpit, and is fitted with a gun ring of 0 86 m diameter which mounts a Parabellum machine gun



Three-Quarter Front View from Below

Engine and Air Screw—The engine is a 6-cylinder Benz, of the vertical water-cooled type, which develops 225 hp Two main fuel tanks, of 249 liters total tankage, are fitted in the body, a small auxiliary tank is mounted on upper left wing The fuel supply insures a flight endurance of 3¼ hours

The cylinder heads, which protrude from the body, are covered with a quick-detachable cowling of sheet metal the exhaust collector has the form of a slightly curved vertical chimney.

The air screw is a Garuda and has a diameter of 3.04 m.; it is fitted with a nose cap

The radiator is of the honeycomb type and contains 35 liters of water It is fitted to the upper plane, where it is held in place by two struts abutting against the forward cabane struts.

The amount of cooling surface exposed to the air stream is regulated by a sturdy linen curtain which is controlled from the pilot's seat and can be made to cover a greater or lesser radiating area. This system of radiation control is apparently more satisfactory, because more simple and rational, than the system operating on the principle of the Venetian blinds.

Undercarriage—This is of the usual V-type and is built up of streamlined wooden struts. The axle is of the continuous type and is enclosed in a wooden fairing, rubber bands serve as shock absorbers

The tail skid is of wood and is reinforced with four steel leaves of 2 mm. thickness

Camouflage—The camouflage scheme of this machine is the following the upper face of the planes and of the tail plane and elevator is painted light green and lavender, while the lower face of these surfaces is painted light blue.

The model C V L V G biplane appears to be destined in particular for photography work, for there is an aperture in the floor of the body for passage of a camera No bomb gear was found on this machine

Kite Balloon Work

According to *The Aeroplane* it was not until the early months of 1915 that the Kite Balloon division of the R N.A.S came into being When the demand for observation balloons for the Dardanelles operation came through in March of that year the Royal Navy was able to send out a completely equipped Kite Balloon Section in a specially fitted steamer The vessel, the "Manica," a converted tramp, which arrived just a month after the demand was made, immediately proved the value of the unit Within three days a Turkish camp was shelled under the direction of the kite balloon, and the occupants thrown into confusion, while in the following week the "spotter" directed fire on the Gaba Tepe position, which resulted in the destruction of the barracks.

However, the triumph came before April was out, for from their aerial perch the observers spotted, lying quietly in the water on the other side of the Peninsula, out of sight of our warships, a large Turkish transport The transport apparently considered herself quite safe H M S "Queen Elizabeth" was operating near by the balloon ship, and the bearings of the Turkish vessel were given her The first shot fell short. By this time the other ships near by were beginning to take an interest in what was happening to "Elizabeth's" invisible target, which was lying nine miles the other side of the Peninsula. A second shot went nearer the mark Again, the direction was corrected, and a third heavy projectile screamed overland By the telephone wire of the kite balloon came the words, "Got her She's sinking by the head"

Aeronautical Patents

GRANTED MAY 7 1918

1 264 937—To Otton E Ilgan, New York and Carl Ilgan Corona, N Y Flying machine

1,264,988—To Gustave Nordstrom Winnipeg Manitoba Can Automatic steering and stabilizing apparatus for aircraft

1,265 392—To Adolphe Clement Bayard Levallois Perret France, Dirigible of the rigid type

1 263 078—To Thomas M Finley Westplains Mo Aerocruiser

1 26? 848—To Thomas M Finley Westplains, Mo Plane for airships.

Digest of the Foreign Aeronautical Press

***Flight*, May 23, 1918**

The Austrian Berg Pursuit Biplane—Simplicity appears to be the keynote of design in the Austrian Berg pursuit biplane, both as regards aero-dynamic and structural design The machine has every appearance of being designed chiefly with a view to rapidity of production, but this has been attained by a studied simplicity of detail rather than by any scamping in workmanship The latter is really quite good, and possibly better than that of many German machines.

In this machine the top plane obstructs the view of the pilot only to a small extent, this has been accomplished not so much by reducing the interplane gap as by making the body very deep and placing the pilot fairly high inside the body Extra depth of the body is mainly provided by a considerable deepening of the turtle back, as may be seen in the accompanying illustration

The body is covered with three-ply wood, but, unlike the Albatros C V, the internal structure of the Berg is built up of only four longitudinals, there being no intermediate longitudinals. The turtle back has roughly the shape of a man's head and shoulders, the object being obviously to streamline the pilot's head without obstructing the view to any great extent Except in front, about the cockpit, the turtle back does not cover the whole width of the flat top of the body, but comes to a vertical point in front of the vertical fin

The cockpit is very comfortable, the deep top efficiently screening the pilot's face, while by leaning his head slightly the pilot can easily look past the nose of the machine, so that there is really no blind spot beyond a few yards ahead of the airplane. The fact that the chord line of the upper plane passes through the pilot's line of vision renders the view forward and upward particularly good

A point of minor importance, yet worthy of consideration, is furnished by the arm rests which are fitted to the pilot's seat and enable the pilot to rest one arm while working the control lever with the other On a long flight this arrangement would seem very commendable from the viewpoint of comfort.

The controls consist of a universally mounted lever and a foot bar The control lever is forked around a longitudinal rocking shaft and oscillates forward and backward for operating the elevator This fore and aft movement of the control lever is limited by appropriate anchor wires, which has the effect of preventing damage to the elevator when the machine is on the ground

The ailerons are operated from the control lever by a vertical crank, pointing upward, to which they are connected, by means of positive cables. These cables are attached to the ailerons by means of cranks resting in slots in the planes, to which they are so fitted that it is the return cable which pulls the wing flap down

The rudder bar is of the T-type, that is, the control cables are attached to a crank projecting forward at right angles to the foot bar The foot guards consist of two layers of spiral springs.

The engine, a 200 hp Austro-Daimler, which is shown removed in the accompanying sketch, appears to have been totally enclosed by a cowling The engine bed consists of two bearers made of three laminated wood, which are mounted on four transverse partitions The armament consists of two machine guns fitted with interrupter gears.

The wings are of equal span, the top wing is notable for having a distinct reverse curvature, beginning behind the rear spar, and presenting a considerable area of concave surface.

The tail planes are built of steel tubing throughout. The stabilizer is chiefly remarkable for its double curvature, which section is attained by bending the single tubes forming the ribs to the desired curvature.

***L'Aerophile*, April 1-15, 1918**

The A E G Three Seater—Two German airplanes of A E G three-seater, bombing model recently made a forced landing within the French lines

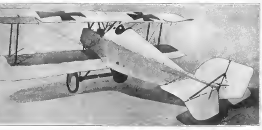
The A E G three-seater is a twin-engined biplane of 18 m. upper, and 17 30 m lower span Its overall length is 9 80 m. and its wing area 75 sq m The power plant consists of 260 hp 6-cylinder Mercedes engines which actuate airscrews of 3.10 m diameter and 2 m pitch The fuel supply is carried in three tanks having a total tankage of 300 liters, two of these are auxiliary tanks of 50 liters capacity each The endurance of the machine is about four hours.

The machine is entirely built of steel, including the wing frames The wings have a slight sweep back, no stagger, and only the lower wing is set at a transverse dihedral Only the upper plane carries ailerons, these are of the balanced type The body is remarkably short and squat in appearance.

The armament consists of two machine guns which are mounted on the forward and after cockpits on gun rings. The after gun can be shifted downward to fire through a trap door fitted in the body Eighteen 12½ kg and seven 50 kg bombs are normally carried by this machine—that is a total of about 500 kg.

The horizontal speed, fully loaded is about 150 km

Both of the captured machines carried three parachutes.



Three-Quarter Rear View of the Berg Pursuit Biplane

News of the Fortnight

Ryan Favors Aeronautical Advertising

In view of the misunderstanding regarding the advertising of aeronautical materials and supplies that many manufacturers have labored under, the opinion printed below from John D Ryan, director of aircraft production, is of special interest. From the reading of this letter, it will appear that no ban is placed on advertising by the fact that a manufacturer is a contractor for the United States Government, or that he is engaged in executing orders for the Air Services. The only restraint is in divulging information that might be of value to the enemy, such as no patriotic manufacturer or publisher would allow to be printed Mr Ryan's letter follows

The Aircraft Board,
Washington, D C,
May 29, 1918.

Mr. George Newbold,
Care Aviation and Aeronautical Engineering,
New York City

Dear Sir

I have given some thought to your communication of May 23, 1918, regarding advertising by manufacturers making aeronautical material for the War Department The purpose of Article XX in the aeronautical contracts, prohibiting the exploitation of the product manufactured, was two-fold, namely—to prevent information of military value from falling into the hands of the enemy and to insure the Government against interruption of production by disaffected persons from a too widely disseminated knowledge of the exact localities where the work was proceeding At the outset it would seem that both of these considerations were of sufficient importance to warrant the restriction

As the work progressed some publicity has necessarily been given to the matter The rule might well be relaxed as to the second consideration noted above, it could hardly be relaxed as to the first consideration It is not, however, the intention of Article XX to prevent all advertising by contractors. There has been, as far as I am informed, no restriction put upon manufacturers from advertising the fact that they are manufacturers of aircraft material and that they are contractors to the United States Government In fact, such advertisements appear constantly in aeronautical journals, and, as far as I am advised, without objection from the War Department It would not be proper for the manufacturer to advertise the quantities or types of articles which he is making for the War Department If he desires to advertise more than the fact that he is a manufacturer of aircraft and that he is a contractor to the United States Government, then he should submit the material he desires to publish to this office, and I can assure you that such liberality will be had in the rulings as will be consistent with the public safety

Advertising expense is excluded as an element of cost in cost plus contracts, and I think properly so For the present, at least, I do not see how the Government can receive any adequate return from the advertising of contractors, and, while that is the case, I do not see how there would be any justification for paying out public moneys to meet the same

We want the cooperation of the trade journals who are interested in this matter, as we want the cooperation of the American people in the important and difficult task we are attempting to perform.

Articles other than advertising, which you desire published in respect to the development of aircraft designed to aid the accomplishment of this work, will have our earnest and prompt consideration.

Very truly yours,
(Signed) John D. Ryan,
Director of Aircraft Production

Air Raid Precautions

Following the appearance of enemy submarines on the Atlantic coast steps were promptly taken by the city authorities of New York to anticipate the possibility of air raids by machines possibly carried on board the U-boats.

Police Commissioner Enright after consulting with military and city authorities ordered all display lights, advertising signs or special illuminations throughout the city, including the seashores, discontinued until further orders. This, however, did not include city lights In official buildings and dwelling houses where lights are used, shades had to be drawn wherever possible to do so.

The order was despatched to all stations and preparations hastily made for its immediate enforcement. The city has now become darker than it was in the fuel saving days.

The following statement was also issued by the Police Commissioner.

"The Police Department desires to notify all residents of this city, through the press, that in the event of a raid on this city by enemy airplanes the following signals will be given

"Siren horns or whistles will be sounded continuously for ten minutes. When this signal is given every one should immediately open the windows of their homes or offices and go at once to the cellar of the premises. After the danger has passed a signal will be given by short blasts of siren horns or whistles at intervals of one minute each for a period of twenty minutes"

New Air Service Insignia

The reorganization of the Army Air Service as a separate branch of the War Department is emphasized by the adoption of new collar ornaments for officers and enlisted men of the Air Service

The new insignia for officers, which takes the place of the crossed flags of the Signal Corps, is published for the first time in the accompanying cut. The perpendicular propeller measures 1 inch in height, which is the standard height of the collar ornaments of other branches of the Army. The wings measure 1¾ inches from tip to tip. The propeller will appear in silver while the wings are bronze.

A regulation size bronze button showing the same design on its face will be worn by all enlisted men on one side of the collar, while on the other side the bronze U S will be worn.

The new hat cord of the air service will be green and black.

Col R E. Wyllie of the General Staff of the Army is the officer who selected the new Air Service Ornaments.

Secretary Baker Visits Standard Plant

On June 6 Secretary of War Baker paid his first visit to an airplane factory Returning from New York to Washington, Secretary Baker decided to see an aircraft factory for the first time Notwithstanding the fact that he spends millions on aircraft for the Government, he had never seen an aircraft factory

Mr Baker visited every part of the plant of the Standard Aircraft Corp, Elizabeth, N J, including the engineering laboratory and other departments which are guarded with much secrecy.

Some thirty executives of the factory were called by Harry B Mingle, president of the Standard Aircraft Corporation, to meet the Secretary

Everybody else in the plant then wanted to see and hear the Secretary, so an outdoor meeting was arranged and messengers summoned the workers. When they assembled Mr. Baker told them something of his experiences at the front.

The Dragon Is Out

The Dragon is the name of a new publication that has been issued by the Fafnir Bearing Co, New Britain, Conn

To Foster Irish Linen Trade

United States Consul Hunter Sharp at Belfast, Ireland, reports that the Irish Linen Corp, an association "to promote the consideration and discussion of all questions affecting the Irish linen industry" has filed an application for registration as a limited liability, no profit organization.

New Coastal Air Stations

Since the annual Army Appropriation Bill was passed by the House requests for additional appropriations, totaling \$164,491,457, have been made by the War Department.

Of the latter amount \$16,000,000 is specified for establishing sixteen balloon and seaplane stations, thirteen of which it is proposed to establish on the Atlantic seaboard and three on the Gulf coast.

\$100,000,000 Airplane Manufactory

At the request of John D. Ryan, in charge of aircraft production, Senator Chamberlain, Chairman of the Committee on Military Affairs, June 10, introduced a bill for the creation of a \$100,000,000 corporation to handle airplane construction.

The intention of the measure is to speed up still further the production of airplanes for the American Army and to put the whole matter on a strictly business basis. Under Senator Chamberlain's bill, the new corporation is to be Government controlled, and is to have the most complete charge of aviation from the production angle.

One of the purposes of the corporation will be to synchronize the activities of aircraft builders here and abroad so that the needs of the American and foreign builders for materials produced or parts fabricated in the United States can be known sufficiently in advance to insure regularity in supply and reasonableness in prices.

The Military Affairs Committee is to consider the measure at once, and is expected to report it without delay so that actual preparations may be started as soon as possible.

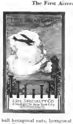
The Air Mail

The Post Office Department issued the following summary of results of the first two weeks of the air mail service:

"With the arrival of the airplane mail in New York on May 28 at 2.30 p.m., the first two weeks' service of the Airplane Mail Service operated by the army for the Post Office Department between Washington, Philadelphia and New York has been completed to the satisfaction of the postal authorities. Out of the twelve trips, eight were completed before 3 o'clock in the afternoon and two before 3.50 p.m. One trip was completed at 2.25 p.m. and two at 2.34 p.m. There were two delays when the mail reached New York at 4.45 p.m. The airplane mail from the North arrived in Washington six times before 3.30 p.m., twice between 3.30 and 4.00 p.m., and four times after 4.00 p.m.

The Post Office Department is considering the extension of the system to Boston. It will be about two months before regular trips will be made.

The First Aircraft Parts Catalog



The first catalog devoted exclusively to metal parts for aircraft has been issued by the Erie Specialty Co., 8 West 40th St., New York City, whose main plant is at Erie, Pa. This catalog, which is attractively gotten up, consists of 24 pages of heavy coated paper and a four-page cover, the front of which is printed in blue and black on gray stock and shown in the accompanying engraving. This booklet measures 5¾ inches wide by 10 inches high.

The inside title page consists of a reproduction from an artistic pen-and-ink drawing, while on the other pages are told the aims of the company "to produce 100 per cent quality," together with details of sizes of hexagon head bolts, ball hexagonal nuts, hexagonal castellated ball nuts, hexagonal castellated nuts and flat head clevis pins. In addition there is supplied a telegraph code for standard Erie parts and a page is devoted to the subject of Erie cooperation. This catalog should be a useful reference book for all aeronautical engineers and mechanics.

S. A. E. Meeting at Dayton

After the demonstration of the Liberty Engine, for which permission has just been granted by Washington, one of the features of the Convention of the Society of Automotive Engineers, held in Dayton, Ohio, June 16, 17 and 18, is the special dinner given in honor of Orville Wright, who, with his brother Wilbur, was the first man to perfect a successful heavier-than-air machine.

In view of the importance of aircraft in the present world war, the tribute is particularly fitting at this time to the Wright Brothers, in Dayton, Ohio—their home, and where all of their experimenting was done. This year the S. A. E. Convention is devoted strictly to the war, and to the machines and other devices that are making it possible for us to win.

A number of unique features are provided by the Convention Committee, for the entertainment as well as enlightenment of the visitors in various win-the-war devices.

The reservations for the Orville Wright dinner have been limited to 1200. President C. F. Kettering will act as toastmaster and the Governor of Ohio, James M. Cox, will be one of the principal speakers at the banquet.

The meetings are held at Triangle Park in the open air, and the published program follows:

Program

SATURDAY, JUNE 15

10.00 A.M.—Meeting of eight divisions of Standards Committee at Dayton Engineers Club.

SUNDAY, JUNE 16

10.00 A.M.—Meeting Standards Committee, Dayton Engineers Club.
1.00 P.M.—Meeting S. A. E. Council, Dayton Engineers Club.
8.00 P.M.—Section Conference, Dayton Engineers Club.

MONDAY, JUNE 17

9.00 A.M.—Registration and badges, entrance Triangle Park.
9.30 A.M.—Exhibits in meetings pavilion.
a Airplane engines.
b Airplane wings and parts.
c Liberty engine and parts.
10.00 A.M.—Business session. Meetings pavilion.
a President's remarks.
b Treasurer's report.
c Membership Committee's report.
d Section Committee.
e Publication Committee.
f Election Nomination Committee.
g Constitution amendments.
h New business.
i Standards Committee's report.
12.30 noon—Luncheon, dining hall at Triangle Park.
1.15 P.M.—Machine firing through propeller.
1.30 P.M.—Petroleum refining, paper and demonstration. C. W. Stratford.
3.00 P.M.—Heavy oil engines for automotive purposes.
a S. E. Sargent.
b F. L. Scott.
4.00 P.M.—Airplane demonstrations over park.
a Airplane raid on trenches.
b Formation flying.
c Stunt flying.
d Maneuvers.
e Bombing.
Opportunity for examining engine and plane exhibits in meetings pavilion.
7.00 P.M.—Orville Wright dinner, dining hall in Triangle Park.
10.00 P.M.—Movies in front of baseball stand, Triangle Park. Illuminations.

TUESDAY, JUNE 18

9.00 A.M.—Meetings pavilion open for examination of airplane engines, planes and Liberty engine exhibits.
9.30 A.M.—Demonstration manufacturing machine in Triangle Park.
10.00 A.M.—Address, Propeller Design. F. W. Caldwell.
10.20 A.M.—Address, Present Day Problems in Aeronautics. W. B. Stout.
10.50 A.M.—Address, Airplanes of Today. F. L. Faurote.
11.20 A.M.—Address, Comparison of Aviation Engines. Mr. Lewis.
11.45 A.M.—Possible report on Liberty engine tests.
12.30 noon—Luncheon, dining hall Triangle Park.
1.30 P.M.—Reports on International aircraft conference.
a J. M. Manly.
b H. H. Ehrman.
c C. F. Clarkson.
2.15 P.M.—Symposium on tractor development.
a C. M. Eason.
b H. T. Davies.
c R. O. Hendrickson.
d Dent Parrett.
3.30 P.M.—Standardization in transport vehicles.
a Captain Crosby, England.
b Captain Vanderville, France.
4.00 P.M.—Demonstrations and exhibits.
a Farm tractors.
b Ordnance vehicles.
c Quarter vehicles.
d Medical corps vehicles.
e Miscellaneous.

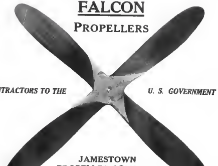
WEDNESDAY, JUNE 19

Dayton Factory Visits.—Those members desiring to visit Dayton factories will do so on this date. It will be necessary to signify Monday or Tuesday what factories you desire to visit and to fill out application cards at information bureau, Triangle Park or Miami Hotel.

A full report of the meeting will be printed in the next issue of AVIATION AND AERONAUTICAL ENGINEERING.

FALCON

PROPELLERS



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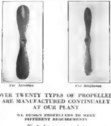
Propeller Manufacturers



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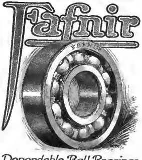

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America's largest watch manufacturer and America's greatest instrument manufacturers recognize R L M to be supreme in its field

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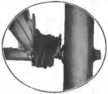
For Shock Absorbers on Airplanes



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THE book on aviation. Approved by the War Department.

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AVIATION 6-15

Aeronautical Trade Directory

AVIATION AND AERONAUTICAL ENGINEERING will furnish information and addresses of companies listed below.
Names of Advertisers in this issue are printed in capitals
See Index to Advertisers on page 710

ACCESSORIES AND INSTRUMENTS

Advance Felt Specialty & Cutting Co
King, Julius, Optical Co.
The Moto Meter Co
National Gauge & Equipment Co.
O'Hara Waltham Dial Co.
Rieker, Walter
SPERRY GYROSCOPE CO
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Des Lauriers Aircraft Corp.
Dewey Aeroplane Co
Engel Aircraft Co.
Falcon Mfg. Co.
Fisher Body Corp
Fowler Airplane Corp.
Gallaudet Aircraft Corp
Heinrich A. E. Corp
LANZIUS AIRCRAFT CO.
Lawrence-Lewis Aeroplane Co
LAWSON AIRCRAFT CORP
Lewis & Vought Corp.
Loening Aeronautical Eng. Corp
Lougren Aeroplane Co.
L. W. F. ENGINEERING CO
MARTIN GLENN L. CO.
Michigan Aircraft Corp
ORDNANCE ENGINEERING CORP.
Patterson Aeroplane Co.
Peirce, Sam'l S., Aeroplane Corp
Smith Kyle, Aircraft Co.
Sperry, Lawrence Aircraft Co
Springfield Airplane Co
STANDARD AIRCRAFT CORP
Sturtevant Aeroplane Co.
THOMAS-MORSE AIRCRAFT CORP
The Willys-Morrow Co
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Gyro Motor Co.
HALL-SCOTT MOTOR CAR CO.
Kemp Machine Works.
Kessler Motor Co.
Knox Motors Co.
Nordyke & Marmon
Packard Motor Co.
Roberts Motor Mfg. Co.
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Springfield Motors Co
Sterling Engine Co.
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Welch Mfg Co
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Willys Morrow Co
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ALUMINUM CASTINGS CO
ALUMINUM CO. OF AMERICA
American Metal Co., Ltd
LEVETT, WALKER M., CO
LEYGRAND & CO
McAdamite-Aluminum Co.
SO-LUMINUM MFG & ENG CO. (SOLDER)
STIMPSON, EDWIN B., CO.
United Smelting & Aluminum Co.

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America Trans-Oceanic Co.
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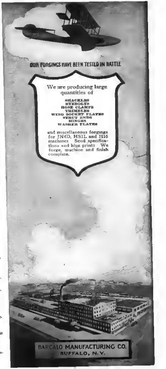
(Continued on page 699)



(Continued from page 697)

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Gurney Ball Bearing Co.
HESS-BRIGHT MFG. CO
NEW DEPARTURE MFG. CO
NORMA COMPANY OF AMERICA
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Custer Specialty Co. (Statoscope)
Gas Engineering Co. (Gas Plants)
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United States Rubber Co.

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(Continued on page 701)

(Continued from page 699)

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(Continued on page 703)

(Continued from page 701)

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